# PATENT ABSTRACTS OF JAPAN

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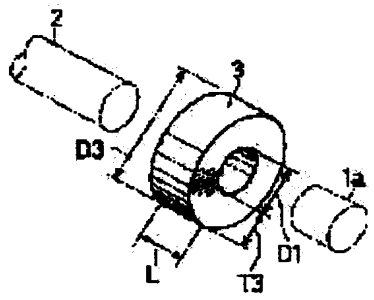
## (54) METHOD FOR FORMING ANNULAR BODY WITH COLD PRESS

(57)Abstract:
PURPOSE: To surely remove fine cracks without changing any metallographic structure and to easily make a postprocessing by cutting and removing the surface hardened part of the internal circumference of an annular work whose surface is hardened caused by the punching movement of a punch by a prescribed amount, and executing the postprocessing.
CONSTITUTION: This method is an annular body forming method with a cold press where a central part of a circular column like or cylinder like metal work is punched with a punch 2 and an annular body is formed, the surface hardened part of the internal circumference of the ring like work 3 whose surface is hardened caused by the punching movement of the punch 2 is cut and removed by a prescribed amount, thereafter the postprocessing is executed.

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* NOTICES *



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## CLAIMS

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[Claim(s)]
[Claim 1] Cylindrical or the cycle shaping approach by the cold pressing which carries out specified quantity cutting removal of the hard facing part of ring-like work-piece inner circumference where it is the cycle shaping approach by the cold pressing which pierces the core of a cylinder-like metal work piece by punch, and fabricates a cycle, and the front face was hardened by blanking migration of above-mentioned punch, and performs post processing.
[Claim 2] The ring-like metal work piece with which the core of a cylinder-like metal work piece was pierced by the 1st punch, and then the core was pierced It is the cycle shaping approach by the cold pressing which pierces to coincidence by the 2nd punch which has the minor diameter guide section and the major-diameter punch section, and fabricates a major-diameter cycle for a minor diameter cycle to coincidence. The cycle shaping approach by the cold pressing which carries out specified quantity cutting removal of the hard facing part of minor diameter cycle inner circumference where the front face was hardened by blanking migration of the 1st punch of the above, and the hard facing part of the minor diameter cycle periphery on which the front face was hardened by relative blanking migration of each cycle, and major-diameter cycle inner circumference, respectively, and performs post processing.
[Claim 3] The above-mentioned specified quantity is claim 1 set as the value which expected allowances cost in the depth of the minute crack by hard facing, or the cycle shaping approach by cold pressing given in two.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the cycle shaping approach by cold pressing which pierces the core of metal work pieces, such as a product made from Fe of the shape of cylindrical or a cylinder, and a product made from SUJ2 (high-carbon-chromium bearing steel), by punch, and fabricates a cycle.
[0002]
[Description of the Prior Art] In order to fabricate cycles, such as cycles, such as an inner ball race of bearing, an outer race, and a pyro, or a cage, and a sleeve, by cold pressing conventionally For example, SUJ2 (% [ of carbon / 0.95 - 1.10 ], and 0.15 - 0.35% of silicon) Manganese 0.50% The following, less than [ Lynn 0.025% ], less than [ sulfur 0.025% ], 1.30 - 1.60% of chromium The metal work piece of the product made from bearing steel which has a science component, and others is arranged to a dice. After piercing the core of this work piece by punch and fabricating a cycle, for example, in fabricating to the outer race of bearing, cold rolling processing is carried out using a mandrel, a support roller, and a shaping roller, and it accomplishes this cycle with an outer race.
[0003] When piercing an above-mentioned work piece by punch and fabricating a cycle, ring-like work-piece inner skin However, the impact at the time of blanking migration of punch, Since plastic hardening is carried out to a high degree of hardness (the Rockwell hardness inner skin when a material is SUJ2 about 395) by friction etc. to other parts, [ as opposed to / For example, / the Rockwell hardness of other parts being about 40 ] When fabricating to the outer race 81 of bearing as shown in drawing 8 for example, There was a trouble that two or more minute crack (crack) 83 -- occurs notably in the annular crevice 82 for bearing arrangement, above-mentioned minute crack 83 -- becomes still larger as shown in drawing 9 at the time of diameter expansion by above-mentioned cold rolling processing, and commercial production became difficult.
[0004] Although it is possible to anneal in order to solve such a trouble (to cool slowly and to heat-treatment-operate it by the thing of softening of annealing, annealing, iron, or steel, after heating to suitable temperature for adjustment of the crystalline structure or removal of internal stress), and to process, even if it performs annealing processing, since it remains and a metal texture changes with annealing, the above-mentioned minute crack 83 is not desirable.
[0005]
[Problem(s) to be Solved by the Invention] Without changing a metal texture in any way by carrying out specified quantity cutting removal of the hard facing part of ring-like work-piece inner circumference where the front face was hardened by blanking migration of punch, and performing post processing, invention of this invention according to claim 1 removes a minute crack certainly, and aims at offer of the cycle shaping approach by the cold pressing which can attain easy-ization of post processing.
[0006] In the cycle shaping approach which invention of this invention according to claim 2 pierces to coincidence the ring-like metal work piece with which the core was pierced by punch of two-step structure, and fabricates a minor diameter cycle and a major-diameter cycle to coincidence By carrying

out specified quantity cutting removal of the inside-and-outside periphery predetermined part of each cycle where the front face was hardened by blanking migration of punch and relative blanking migration of a cycle, and performing post processing Without changing a metal texture in any way, a minute crack is removed certainly and it aims at offer of the cycle shaping approach by the cold pressing which can attain easy-ization of each post processing of a minor diameter cycle and a major-diameter cycle.
[0007] Since the depth like the hard spot which invention of this invention according to claim 3 combines with the purpose of invention above-mentioned claim 1 or given in two and by which the front face was hardened (depth which became the degree of hardness which a minute crack tends to generate) is 0.3mm, This specified quantity at the time of carrying out specified quantity cutting removal of the hard facing part because a setup (it will be set as the value which expected allowances cost in the depth of a high degree-of-hardness-ized layer if it puts in another way) makes it the value (for example, 0.4mm) which expected allowances cost in the depth of a minute crack A minute crack is removed completely and it aims at offer of the cycle shaping approach by the cold pressing which can attain easy-ization of post processing.
[0008]
[Means for Solving the Problem] Invention of this invention according to claim 1 is characterized by cylindrical or being the cycle shaping approach by the cold pressing which pierces the core of a cylinder-like metal work piece by punch, and fabricates a cycle, and being the cycle shaping approach by the cold pressing which carries out specified quantity cutting removal of the hard facing part of ring-like work-piece inner circumference where the front face was hardened by blanking migration of above-mentioned punch, and performs post processing.
[0009] Invention of this invention according to claim 2 pierces the core of a cylinder-like metal work piece by the 1st punch. Next, it is the cycle shaping approach by the cold pressing which pierces to coincidence the ring-like metal work piece with which the core was pierced by the 2nd punch which has the minor diameter guide section and the major-diameter punch section, and fabricates a major-diameter cycle for a minor diameter cycle to coincidence. The hard facing part of minor diameter cycle inner circumference where the front face was hardened by blanking migration of the 1st punch of the above, It is characterized by being the cycle shaping approach by the cold pressing which carries out specified quantity cutting removal of the hard facing part of the minor diameter cycle periphery on which the front face was hardened by relative blanking migration of each cycle, and major-diameter cycle inner circumference, respectively, and performs post processing.
[0010] Invention of this invention according to claim 3 combines with the configuration of invention above-mentioned claim 1 or given in two, and is characterized by the above-mentioned specified quantity being the cycle shaping approach by the cold pressing set as the value which expected allowances cost in the depth of the minute crack by hard facing.
[0011]
[Function and Effect of the Invention] According to invention of this invention according to claim 1, the core of a metal work piece is pierced by punch, a cycle is fabricated, but specified quantity cutting removal of the hard facing part of ring-like work-piece inner circumference where the front face was hardened by blanking migration of above-mentioned punch is carried out, it sets after that, and post processing is performed.
[0012] For this reason, since cutting removal of the part where the minute crack could be removed certainly and the degree of hardness became high is carried out without changing a metal texture in any way, while being able to attain easy-ization of post processing, it is effective in the ability to aim at improvement in the product yield of the completed cycle.
[0013] According to invention of this invention according to claim 2, the core of a cylinder-like metal work piece is pierced by the 1st punch. Next, the metal work piece of the shape of a ring by which the above-mentioned core was pierced by the 2nd punch with the minor diameter guide section and the major-diameter punch section is pierced. The hard facing part of minor diameter cycle inner circumference where the minor diameter cycle and the major-diameter cycle were fabricated by coincidence, and then the front face was hardened by blanking migration of the 1st above-mentioned

punch, Specified quantity cutting removal of each hard facing part of the minor diameter cycle periphery on which the front face was hardened by relative blanking migration of each cycle, and major-diameter cycle inner circumference is carried out, respectively, it sets after that, and post processing is performed.

[0014] Consequently, while being able to ** if easy-ization of each post processing of a minor diameter cycle and a major-diameter cycle is attained since cutting removal of the part where the minute crack could be removed certainly and the degree of hardness became high is carried out without changing a metal texture in any way, it is effective in the ability to aim at improvement in the product yield of each completed cycle.
[0015] According to invention of this invention according to claim 3, it combines with an effect of the invention above-mentioned claim 1 or given in two. The above-mentioned specified quantity is the value (since a high degree of hardness is formed to a depth of 0.3mm at the usual work piece) which expected allowances cost in the depth of the minute crack by hard facing. Since cutting cost was set up for setting up by 0.4mm of edge thickness difference (it will be set as the value which expected allowances cost in the depth of a high degree-of-hardness-ized layer if it puts in another way), a minute crack and a high degree-of-hardness-ized layer are removed completely, and it is effective in the ability to attain easy-ization of post processing.
[0016]
[Example] One example of this invention is explained in full detail based on a drawing below. A drawing forms the ring-like work piece 3 with which the work piece [ that the product made from SUJ2 is cylindrical (the shape of a solid) ] 1 was formed as the cycle shaping approach by cold pressing was shown and it was first shown in drawing 1 , core 1a of the above-mentioned work piece 1 was pierced in the shape of a minor diameter cylinder by the 1st punch 2 shown in drawing 2 after arranging this work piece 1 in a dice (not shown), and this core 1a was pierced.
[0017] Drawing 3 is equipped with the 2nd punch 10 which carries out cold pressing processing of the work piece 3 of the shape of an above-mentioned ring and which has a dice 7, and the minor diameter guide section 8 and the major-diameter punch section 9 by showing press equipment with a full capacity of 80t, for example, and keeping having a die hole 4, the work-piece arrangement hole 5, and two or more closing motion chucks 6 and 6.
[0018] The ring-like work piece 3 with which the **** extracted and core 1a was pierced by the work-piece arrangement hole 5 in a dice 7 is arranged. At this time, the minute path clearance C is constituted between the periphery of a work piece 3, and the inner skin of the work-piece arrangement hole 5. This minute path clearance C is pierced, thermal expansion of the work piece 3 is sometimes carried out, and this work piece 3 prevents biting the 2nd punch 10.
[0019] Next, as shown in drawing 4 from the condition shown in drawing 3 , the 2nd above-mentioned punch 10 is pierced and moved in the direction of an arrow head at a predetermined rate (for example, 70 mm/sec) thru/or a high speed (the supersonic speed beyond acoustic velocity and acoustic velocity is included), the above-mentioned work piece 3 is pierced by the cutting part at major-diameter punch section 9 tip, and the minor diameter cycle 11 and the major-diameter cycle 12 are fabricated in the condition that there is no ingredient loss, to coincidence.
[0020] At the time of the double action of the 2nd above-mentioned punch 10, double action of the 2nd punch 10 can be carried out, without the major-diameter cycle 12 and the minor diameter cycle 11 biting the minor diameter guide section 8 and the major-diameter punch section 9, if retreat migration of this 2nd punch 10 is carried out after carrying out migration inhibition of the end face of the major-diameter cycle 12 by the closing motion chucks 6 and 6, as shown in drawing 5 .
[0021] Next, the major-diameter cycle 12 and the minor diameter cycle 11 which keep showing drawing 5 and are located in the predetermined part in a dice 7 are sampled with EJIEKUTO equipment (not shown), and it accomplishes like drawing 6 . In addition, an example of the dimension of each part of drawing 2 , the work piece 3 in drawing 6 , the minor diameter cycle 11, and the major-diameter cycle 12 is as follows. L= 10.1mm, D1=12.0mmphi, D2=21.5mmphi, D3=30.4mmphi, T1=4.75mmt, T2=4.45mmt, and T3=9.2mmt Cold pressing blanking processing of thick T3 from the small work piece

3 is attained to height L.
[0022] Next, the hard facing part of inner circumference 11a of the minor diameter cycle 11 where the front face was hardened by blanking migration of the 1st above-mentioned punch 2 as shown in drawing 7 (plastic hardening), Each hard facing part of periphery 11b of the minor diameter cycle 11 by which the front face was hardened by relative blanking migration of each cycles 11 and 12, and inner circumference 12a of the major-diameter cycle 12 After only the specified quantity b carries out cutting removal with cutting equipment (not shown), respectively, post processing, such as cold rolling processing corresponding to the outer race of the bearing which should be used as a product, an inner ball race, etc., is performed.
[0023] Here, the above-mentioned specified quantity b is set as the value which expected allowances cost in the depth of the minute crack by hard facing. Since the range to a depth of 0.3mm is specifically formed into a high degree of hardness by about 395 by the Rockwell hardness at the usual work piece (plastic hardening), cutting cost is set up by 0.4mm of edge thickness difference.
[0024] Thus, core 1a of the cylinder-like metal work piece 1 is pierced by the 1st punch 2. Next, the metal work piece 3 of the shape of a ring by which above-mentioned core 1a was pierced by the 2nd punch 10 with the minor diameter guide section 8 and the major-diameter punch section 9 is pierced. The hard facing part of minor diameter cycle inner circumference 11a where the minor diameter cycle 11 and the major-diameter cycle 12 were fabricated by coincidence, and then the front face was hardened by blanking migration of the 1st above-mentioned punch 2, Specified quantity b cutting removal of each hard facing part of minor diameter cycle periphery 11b by which the front face was hardened by relative blanking migration of each cycles 11 and 12, and major-diameter cycle inner circumference 12a is carried out, respectively, it sets after that, and post processing is performed.
[0025] Consequently, while being able to ** if easy-ization of each post processing of the minor diameter cycle 11 and the major-diameter cycle 12 is attained since cutting removal of the part where the minute crack could be removed certainly and the degree of hardness became high is carried out without changing a metal texture in any way, it is effective in the ability to aim at improvement in the product yield of each completed cycle. Moreover, since the annealing processing which requires a long time comparatively is unnecessary, compaction of cycle cycle time can be aimed at.
[0026] In addition, the above-mentioned specified quantity b is the value (since a high degree of hardness is specifically formed to a depth of 0.3mm at the usual work piece) which expected allowances cost in the depth of the minute crack by hard facing. Since cutting cost was set up for setting up by 0.4mm of edge thickness difference (it will be set as the value which expected allowances cost in the depth of a high degree-of-hardness-ized layer if it puts in another way), a minute crack and a high degree-of-hardness-ized layer are removed completely, and it is effective in the ability to attain easy-ization of post processing.
[0027] In addition, although SUJ2 (high-carbon-chromium bearing steel) was illustrated as a work-piece material in the above-mentioned example, as for this work-piece material, it is needless to say that you may be other various metals, such as other bearing steel or carbon steel, and Fe, and the direction of an axis line of a die hole 4 is not limited horizontally, and it is not necessary to say that you may be the vertical direction.

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## DRAWINGS

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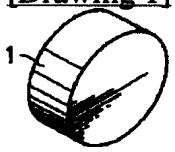
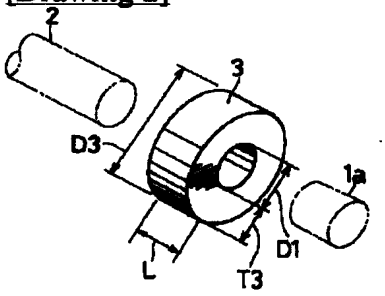
[Drawing 1]



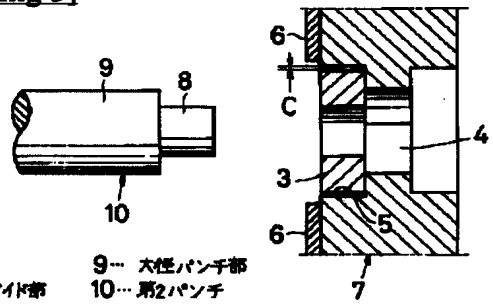

1… ワーク

[Drawing 2]



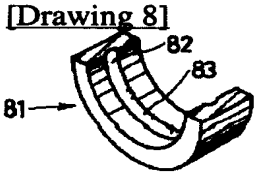

2… 第1パンチ
3… ワーク

[Drawing 3]

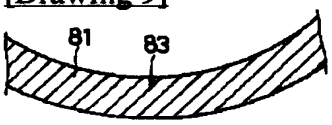



3… ワーク　9… 大径パンチ部
8… 小径ガイド部　10… 第2パンチ

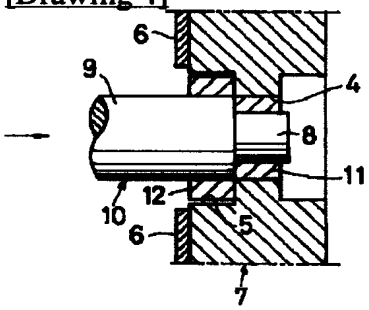
[Drawing 8]



[Drawing 9]

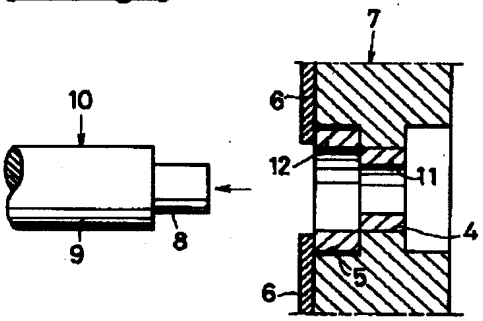



[Drawing 4]



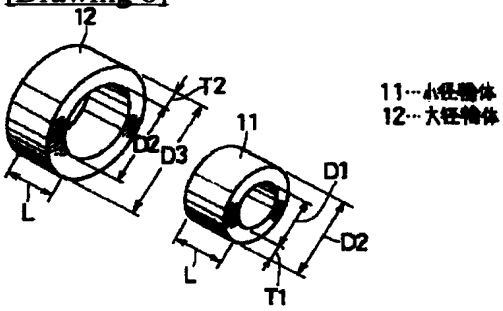

8…小径ガイド部 11…小径軸体
9…大径パンチ部 12…大径軸体
10…第2パンチ

[Drawing 5]



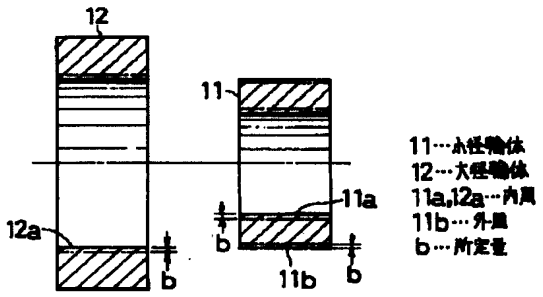

8…小径ガイド部 11…小径軸体
9…大径パンチ部 12…大径軸体
10…第2パンチ

[Drawing 6]




11…小径軸体
12…大径軸体

[Drawing 7]

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引用文献4

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(43)公開日　平成８年(1996)３月19日

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| Ｂ２１Ｊ　5/10 | Ｚ | | | |
| Ｂ２１Ｄ　28/14 | Ａ | | | |

審査請求　未請求　請求項の数３　ＦＤ　（全５頁）

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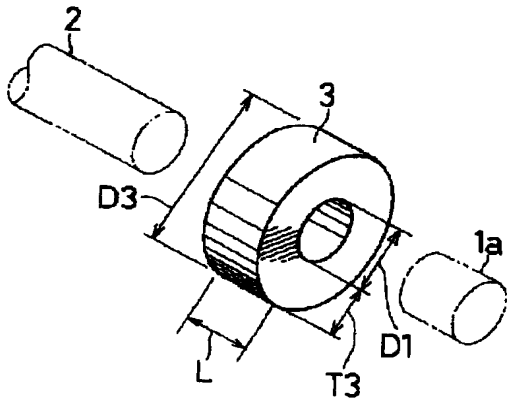
(54)【発明の名称】　冷間プレスによる輪体成形方法

(57)【要約】

【目的】パンチの打抜き移動により表面が硬化されたリング状のワーク内周の表面硬化部位を所定量切削除去して後加工を施すことにより、金属組織を何等変化させることなく、微小クラックを確実に除去して、後加工の容易化を達成することができる冷間プレスによる輪体成形方法の提供を目的とする。

【構成】円柱状もしくは円筒状の金属製ワークの中心部をパンチ２により打抜いて輪体を成形する冷間プレスによる輪体成形方法であって、上記パンチ２の打抜き移動により表面が硬化されたリング状のワーク３内周の表面硬化部位を所定量切削除去して後加工を施すことを特徴とする。




2…第1パンチ
3…ワーク

【特許請求の範囲】
【請求項１】円柱状もしくは円筒状の金属製ワークの中心部をパンチにより打抜いて輪体を成形する冷間プレスによる輪体成形方法であって、上記パンチの打抜き移動により表面が硬化されたリング状のワーク内周の表面硬化部位を所定量切削除去して後加工を施す冷間プレスによる輪体成形方法。
【請求項２】円柱状の金属製ワークの中心部を第１パンチにより打抜き、次に中心部が打抜かれたリング状の金属製ワークを、小径ガイド部と大径パンチ部とを有する第２パンチにより同時に打抜いて小径輪体を大径輪体とを同時に成形する冷間プレスによる輪体成形方法であって、上記第１パンチの打抜き移動により表面が硬化された小径輪体内周の表面硬化部位と、各輪体の相対打抜き移動により表面が硬化された小径輪体外周および大径輪体内周の表面硬化部位とをそれぞれ所定量切削除去して後加工を施す冷間プレスによる輪体成形方法。
【請求項３】上記所定量は表面硬化による微小クラックの深さに余裕代を見込んだ値に設定した請求項１もしくは２記載の冷間プレスによる輪体成形方法。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】この発明は、例えば、円柱状もしくは円筒状のＦｅ製、ＳＵＪ２（高炭素クロム軸受鋼）製などの金属製ワークの中心部をパンチにより打抜いて輪体を成形するような冷間プレスによる輪体成形方法に関する。
【０００２】
【従来の技術】従来、ベアリングのインナレース、アウタレース、ピロー等の輪体あるいはケージ、スリーブ等の輪体を冷間プレスにより成形するには、例えばＳＵＪ２（炭素0.95～1.10% 、ケイ素0.15～0.35% 、マンガン0.50% 以下、リン0.025%以下、イオウ0.025%以下、クロム1.30～1.60% の科学成分を有するベアリング鋼）製その他の金属製ワークをダイスに配置し、このワークの中心部をパンチにより打抜いて輪体を成形した後に、例えばベアリングのアウタレースに成形する場合には、この輪体をマンドレル、サポートローラ、成形ローラを用いて冷間圧延加工してアウタレースと成す。
【０００３】しかし、上述のワークをパンチにより打抜いて輪体を成形する時、リング状のワーク内周面はパンチの打抜き移動時の衝撃、摩擦などにより他部位に対して高硬度（例えば素材がＳＵＪ２の場合には他部位のロックウェル硬さが約４０であるのに対して内周面はロックウェル硬さが約３９５）に塑性硬化されるため、図８に示すように例えばベアリングのアウタレース８１に成形する時、ベアリング配設用の環状凹部８２に複数の微小クラック(crack) ８３…が顕著に発生し、上述の冷間圧延加工による拡径時に図９に示す如く上述の微小クラック８３…が更に大きくなり、製品化が困難となる問題点があった。
【０００４】このような問題点を解決するために焼なまし（焼鈍、annealing 、鉄または鋼の軟化のことで、結晶組織の調整または内部応力の除去のため、適当な温度に加熱した後に、ゆっくり冷却する熱処理操作のこと）処理を施すことが考えられるが、焼なまし処理を施しても上述の微小クラック８３は残存し、かつ焼なましにより金属組織が変化するため望ましくない。
【０００５】
【発明が解決しようとする課題】この発明の請求項１記載の発明は、パンチの打抜き移動により表面が硬化されたリング状のワーク内周の表面硬化部位を所定量切削除去して後加工を施すことにより、金属組織を何等変化させることなく、微小クラックを確実に除去して、後加工の容易化を達成することができる冷間プレスによる輪体成形方法の提供を目的とする。
【０００６】この発明の請求項２記載の発明は、中心部が打抜かれたリング状の金属製ワークを、２段構造のパンチにより同時に打抜いて小径輪体と大径輪体とを同時に成形する輪体成形方法において、パンチの打抜き移動および輪体の相対打抜き移動により表面が硬化されたそれぞれの輪体の内外周所定部位を所定量切削除去して後加工を施すことにより、金属組織を何等変化させることなく、微小クラックを確実に除去して、小径輪体および大径輪体の各後加工の容易化を達成することができる冷間プレスによる輪体成形方法の提供を目的とする。
【０００７】この発明の請求項３記載の発明は、上記請求項１もしくは２記載の発明の目的と併せて、表面が硬化された硬化部位の深さ（微小クラックが発生しやすい硬度になった深さ）は０．３㎜であるため、表面硬化部位を所定量切削除去する際の該所定量を微小クラックの深さに余裕代を見込んだ値（例えば０．４㎜）に設定（換言すれば高硬度化層の深さに余裕代を見込んだ値に設定）のすることで、微小クラックを完全に除去して、後加工の容易化を達成することができる冷間プレスによる輪体成形方法の提供を目的とする。
【０００８】
【課題を解決するための手段】この発明の請求項１記載の発明は、円柱状もしくは円筒状の金属製ワークの中心部をパンチにより打抜いて輪体を成形する冷間プレスによる輪体成形方法であって、上記パンチの打抜き移動により表面が硬化されたリング状のワーク内周の表面硬化部位を所定量切削除去して後加工を施す冷間プレスによる輪体成形方法であることを特徴とする。
【０００９】この発明の請求項２記載の発明は、円柱状の金属製ワークの中心部を第１パンチにより打抜き、次に中心部が打抜かれたリング状の金属製ワークを、小径ガイド部と大径パンチ部とを有する第２パンチにより同時に打抜いて小径輪体を大径輪体とを同時に成形する冷間プレスによる輪体成形方法であって、上記第１パンチ

の打抜き移動により表面が硬化された小径輪体内周の表面硬化部位と、各輪体の相対打抜き移動により表面が硬化された小径輪体外周および大径輪体内周の表面硬化部位とをそれぞれ所定量切削除去して後加工を施す冷間プレスによる輪体成形方法であることを特徴とする。

【００１０】この発明の請求項３記載の発明は、上記請求項１もしくは２記載の発明の構成と併せて、上記所定量は表面硬化による微小クラックの深さに余裕代を見込んだ値に設定した冷間プレスによる輪体成形方法であることを特徴とする。

【００１１】

【発明の作用及び効果】この発明の請求項１記載の発明によれば、金属製ワークの中心部をパンチにより打抜いて輪体が成形されるが、上述のパンチの打抜き移動により表面が硬化されたリング状のワーク内周の表面硬化部位は所定量切削除去され、その後において後加工が施される。

【００１２】このため、金属組織を何等変化させることなく、微小クラックを確実に除去することができ、また硬度が高くなった部位を切削除去するので、後加工の容易化を達成することができると共に、完成された輪体の製品歩留りの向上を図ることができる効果がある。

【００１３】この発明の請求項２記載の発明によれば、第１パンチにより円柱状の金属製ワークの中心部が打抜かれ、次に小径ガイド部と大径パンチ部とをもった第２パンチにより上述の中心部が打抜かれたリング状の金属製ワークが打抜かれて、小径輪体と大径輪体とが同時に成形され、次に上述の第１パンチの打抜き移動により表面が硬化された小径輪体内周の表面硬化部位と、各輪体の相対打抜き移動により表面が硬化された小径輪体外周および大径輪体内周の各表面硬化部位とがそれぞれ所定量切削除去され、その後において後加工が施される。

【００１４】この結果、金属組織を何等変化させることなく、微小クラックを確実に除去することができ、また硬度が高くなった部位を切削除去するので、小径輪体および大径輪体の各後加工の容易化を達成するとができると共に、完成された各輪体の製品歩留りの向上を図ることができる効果がある。

【００１５】この発明の請求項３記載の発明によれば、上記請求項１もしくは２記載の発明の効果と併せて、上述の所定量は表面硬化による微小クラックの深さに余裕代を見込んだ値（通常のワークでは深さ０．３㎜まで高硬度化されるので、切削代を例えば片肉０．４㎜までに設定する）に設定（換言すれば高硬度化層の深さに余裕代を見込んだ値に設定）したので、微小クラックおよび高硬度化層を完全に除去して、後加工の容易化を達成することができる効果がある。

【００１６】

【実施例】この発明の一実施例を以下図面に基づいて詳述する。図面は冷間プレスによる輪体成形方法を示し、まず図１に示す如くＳＵＪ２製の円柱状（中実状）のワーク１を設け、このワーク１をダイス（図示せず）に配設した後に図２に示す第１パンチ２により上述のワーク１の中心部１ａを小径円柱状に打抜いて、該中心部１ａが打抜かれたリング状のワーク３を形成する。

【００１７】図３は上述のリング状のワーク３を冷間プレス加工する例えば全容量８０トンのプレス装置を示し、ダイス穴４、ワーク配設孔５、複数の開閉チャック６，６を有する抜きダイス７と、小径ガイド部８および大径パンチ部９を有する第２パンチ１０とを備えている。

【００１８】上述の抜きダイス７におけるワーク配設孔５に、中心部１ａが打抜かれたリング状のワーク３を配設する。この時、ワーク３の外周とワーク配設孔５の内周面との間には微小クリアランスＣを構成する。この微小クリアランスＣは打抜き時にワーク３を熱膨張させて、該ワーク３が第２パンチ１０に食付くのを防止する。

【００１９】次に図３に示す状態から図４に示す如く上述の第２パンチ１０を矢印方向へ所定速度（例えば７０㎜/sec）乃至高速（音速および音速以上の超音速を含む）で打抜き移動させて、大径パンチ部９先端の刃部で上述のワーク３を打抜いて、小径輪体１１と大径輪体１２とを材料ロスが全くない状態で同時に成形する。

【００２０】上述の第２パンチ１０の復動時には、図５に示すように開閉チャック６，６で大径輪体１２の端面を移動阻止した後に、該第２パンチ１０を後退移動すると、大径輪体１２および小径輪体１１が小径ガイド部８および大径パンチ部９に食付くことなく、第２パンチ１０を復動させることができる。

【００２１】次に図５に示す抜きダイス７内の所定箇所に位置する大径輪体１２および小径輪体１１をエジェクト装置（図示せず）で抜取って図６の如く成す。なお、図２、図６におけるワーク３、小径輪体１１および大径輪体１２の各部の寸法の一例は次の通りである。Ｌ＝１０．１㎜、Ｄ１＝１２．０㎜$\phi$、Ｄ２＝２１．５㎜$\phi$、Ｄ３＝３０．４㎜$\phi$、Ｔ１＝４．７５㎜$^{t}$、Ｔ２＝４．４５㎜$^{t}$、Ｔ３＝９．２㎜$^{t}$で高さＬに対して肉厚Ｔ３が小さいワーク３からの冷間プレス打抜き加工が可能となる。

【００２２】次に図７に示すように、上述の第１パンチ２の打抜き移動により表面が硬化（塑性硬化）された小径輪体１１の内周１１ａの表面硬化部位と、各輪体１１，１２の相対打抜き移動により表面が硬化された小径輪体１１の外周１１ｂおよび大径輪体１２の内周１２ａの各表面硬化部位とを、切削装置（図示せず）によりそれぞれ所定量ｂのみ切削除去した後に、製品にすべきベアリングのアウタレース、インナレース等に対応した冷間圧延加工などの後加工を施す。

【００２３】ここで、上述の所定量ｂは表面硬化による

微小クラックの深さに余裕代を見込んだ値に設定している。具体的には通常のワークでは深さ０．３mmまでの範囲がロックウェル硬さで約３９５に高硬度化（塑性硬化）されるので、切削代を片肉０．４mmまでに設定する。

【００２４】このように、第１パンチ２により円柱状の金属製ワーク１の中心部１ａが打抜かれ、次に小径ガイド部８と大径パンチ部９とをもった第２パンチ１０により上述の中心部１ａが打抜かれたリング状の金属製ワーク３が打抜かれて、小径輪体１１と大径輪体１２とが同時に成形され、次に上述の第１パンチ２の打抜き移動により表面が硬化された小径輪体内周１１ａの表面硬化部位と、各輪体１１，１２の相対打抜き移動により表面が硬化された小径輪体外周１１ｂおよび大径輪体内周１２ａの各表面硬化部位とがそれぞれ所定量ｂ切削除去され、その後において後加工が施される。

【００２５】この結果、金属組織を何等変化させることなく、微小クラックを確実に除去することができ、また硬度が高くなった部位を切削除去するので、小径輪体１１および大径輪体１２の各後加工の容易化を達成するとができると共に、完成された各輪体の製品歩留りの向上を図ることができる効果がある。また比較的長時間を要する焼なまし処理が不要であるため輪体成形時間の短縮を図ることができる。

【００２６】加えて、上述の所定量ｂは表面硬化による微小クラックの深さに余裕代を見込んだ値（具体的には通常のワークでは深さ０．３mmまで高硬度化されるので、切削代を例えば片肉０．４mmまでに設定する）に設定（換言すれば高硬度化層の深さに余裕代を見込んだ値に設定）したので、微小クラックおよび高硬度化層を完全に除去して、後加工の容易化を達成することができる効果がある。

【００２７】なお、上記実施例においてはワーク素材としてＳＵＪ２（高炭素クロム軸受鋼）を例示したが、このワーク素材は他のベアリング鋼あるいは炭素鋼やＦｅ等の他の各種金属であってもよいことは勿論であり、またダイス穴４の軸芯線方向は水平方向に限定されることはなく、上下方向であってもよいことは云うまでもない。

【図面の簡単な説明】

【図１】本発明の冷間プレスによる輪体成形に用いられるワークの斜視図。

【図２】リング状ワーク成形行程を示す斜視図。

【図３】リング状ワークを抜きダイスに配設した状態で示す断面図。

【図４】小径輪体と大径輪体との同時成形行程を示す断面図。

【図５】パンチ後退時の説明図。

【図６】抜きダイスから取出された各輪体の斜視図。

【図７】表面硬化部位の切削行程を示す説明図。

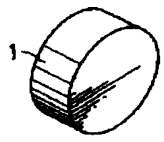
【図８】従来の冷間プレスによるクラック発生状態を示す半裁斜視図。

【図９】従来の冷間圧延時のクラック拡大状態を示す部分拡大断面図。

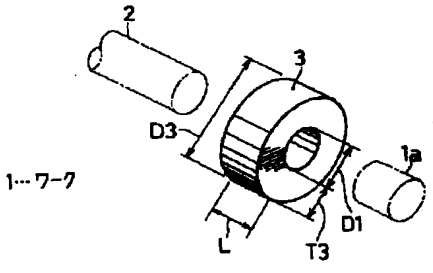
【符号の説明】

| | |
|---|---|
| １．３…ワーク | ２…パンチ |
| ８…小径ガイド部 | ９…大径パンチ部 |
| １０…第２パンチ | １１…小径輪体 |
| １２…大径輪体 | １１ａ．１２ａ…内周 |
| １１ｂ…外周 | ｂ…所定量 |

【図１】

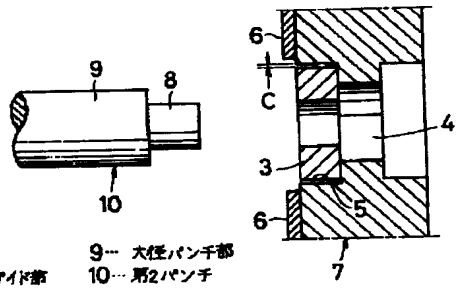


【図２】



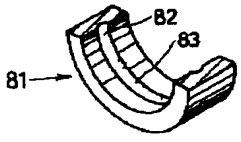

1…ワーク
2…第1パンチ
3…ワーク

【図３】

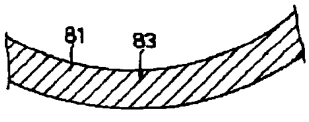



3…ワーク　9…大径パンチ部
8…小径ガイド部　10…第2パンチ

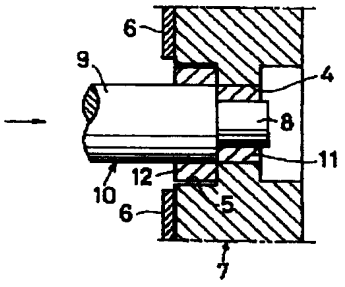
【図８】




【図９】

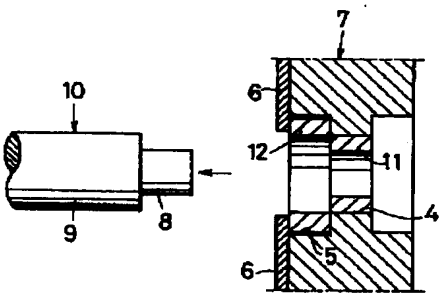


【図４】



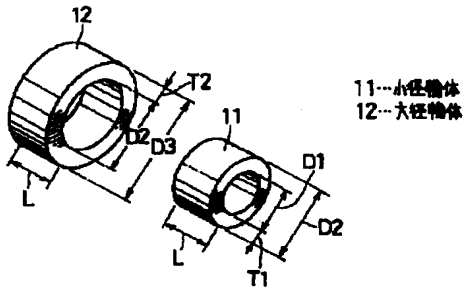

8…小径ガイド部　11…小径軸体
9…大径パンチ部　12…大径軸体
10…第2パンチ

【図５】



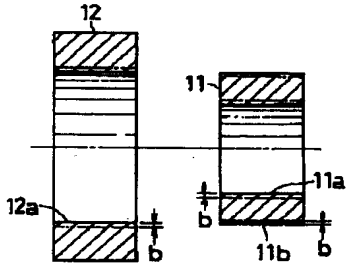

8…小径ガイド部　11…小径軸体
9…大径パンチ部　12…大径軸体
10…第2パンチ

【図６】




11…小径軸体
12…大径軸体

【図７】




11…小径軸体
12…大径軸体
11a,12a…内具
11b…外具
b…所定量